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Robert Bell.
Sir Henry Lefroy's address
Swansea 1880.

SWANSEA, 1880.

ADDRESS
TO THE
GEOGRAPHICAL SECTION
OF THE
BRITISH ASSOCIATION.
BY

Lieut.-General Sir J. H. LEFROY, C.B., K.C.M.G., R.A., F.R.S.,
F.R.G.S.,

PRESIDENT OF THE SECTION.

My recent predecessors in this chair have dealt, with a knowledge and ability with which I cannot vie, not only with great problems in terrestrial physics, such as the genesis of our oceans, continents, and mountain-chains; the circulation of the waters of the ocean, with its consequences on climate; the reciprocal influence of conditions of nature upon man, and of man's ability to modify those conditions; but also on the progress of geographical discovery on the great theatres of political interest or commercial rivalry; and the archaeology of our science, as regards Asia, has been touched by a master's hand. Turning, then, from themes on which I could offer nothing worthy of your attention, I find with a sense of relief, that there is a region of the globe, and it is one with which I have the most personal acquaintance, which has received very little attention at their hands. I refer to the great continent of America, and more especially its northern portion; and I hope for your indulgence if I enlarge a little upon that theme.

How vast have been, in very recent times, the additions to our knowledge in that quarter, how continuous is the progress of discovery, cannot, I think, but worthily occupy your attention for a few minutes. In other regions geography is the pioneer of civilisation and commerce. We look, and often look long, for their footsteps to follow. Here for the first time she has been outstripped, for the telegraph and the railway have tracked the forest or prairie, and traversed the mountains by paths before unknown to her.

I remember that patriarch of science, Sir Edward Sabine, once telling me how eagerly he, as a young man, had desired to retread the footsteps of Lewis and Clarke, whose journey from St. Louis to the Pacific in 1805, was at the time, and must long remain, one of the most remarkable achievements on record.

Let me, then, remind you that within living memory (I grant a long one) no traveller known to fame had crossed the American continent from east to west, except Alexander Mackenzie, in 1793. No traveller had reached the American Polar Sea by land, except the same illustrious explorer and Samuel Hearne. The British

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Admiralty had not long before instructed Captain Vancouver to search on the coast of the Pacific for some near communication with a river flowing into or out of the Lake of the Woods. The fabulous Straits of Annian are to be found on maps of the last century. 'The sacred fires of Montezuma' were still burning in secluded valleys of Upper California when her Majesty ascended the throne.

It is very interesting to observe that De la Hontan, whose name has been recently given by the American geologists to the basin of the great Miocene Sea, now represented by Carson Lake in Nevada, ascended the Mississippi, and even penetrated up the Yellowstone, very nearly to the 'National Park,' at all events into the present territory of Montana, so early as 1637. He introduces into his rude map a head-water lake, on Indian information, which must, I think, be identical with a lake in that reserve. 'Je sçais,' says his biographer, 'que tous les voyageurs sont sujets à caution, et que s'ils ne sont point parvenus au privilége des poëtes et des peintres, il ne s'en faut guère: mais il faut excepter de la noblesse; est il croyable qu'un baron voulut en imposer?' But I am not pursuing the attractive theme offered by historical geography, and must not dwell on the memorable expeditions of Franklin and Richardson, of Bick and Simpson and Rac, but proceed to point out the many agencies at work of late years to open up the continent: the military operations, for example, of the United States' Government against Mexico; the discovery of the precious metals; the explorations for the Union Pacific and Canada Pacific Railways; International Boundary Surveys; the geological surveys of the American and Canadian Governments. These have all resulted in a surprising extension of geographical knowledge, without any of them having it particularly in view. It was a bold figure of speech of Lord Dufferin's which described the Rocky Mountains in 1877 as being nearly 'as full of theodolites as they could hold,' but the Dominion Government has spent about three-quarters of a million sterling on explorations or surveys for their railway, and we have only to glance at a recent map to discover nine sovereign states, and seven territories, west of the Mississippi, bounded by right lines, which neither war nor diplomacy has determined, laid out like garden-plots, to see that neither Asia nor Africa have unfolded more of their secrets in our times, than has the nobler continent where Britain has cast her swarms.

The thoroughness characteristic of the scientific operations of the American Government has been greatly favoured by the physical features of the region of their trigonometrical survey, in the American Cordilleras. Sharp rocky peaks, bare of vegetation, rise to altitudes of 10,000 to 12,000 feet, at convenient distances of 60 to 80 miles apart, so situated as to form well-conditioned triangles, while the purity of the atmosphere makes observation easy. In this manner has an immense region comprising some 87,000 square miles in Nevada, Utah, and Colorado, been topographically surveyed since 1867; not indeed with the detail of a European national survey, but with all the accuracy required for first settlement. The two pre-historic seas, now designated Lake Bonneville, of which Salt Lake is the remains, and Lake La Hontan, already referred to, have been defined, and facts of remarkable physical interest have been ascertained. The evaporation of Great Salt Lake, for example, is no longer in excess of its annual tribute; it has risen 11 feet since 1866. The natural basin of Pyramid Lake is now full, its level has risen 9 feet, and the overflow is filling up Winnemucca Lake in like manner; the latter lake has risen 22 feet, and its area has doubled within the same short period. We cannot allow the geologists to monopolise the interest of these physical changes, which the magnificent volume of Mr. Clarence King has presented to them.

Lying a little to the east and south of the region just referred to is another, which includes yet loftier mountains, and has been surveyed by Professor Hayden. Here, on the tributaries of the rivers Colorado and S. Juan, we find those mysterious monuments of an extinct civilisation and a dying people, the cliff-houses on the Rio Mancos and Rio de Chelly, the Pueblos of the Chaso Cañon; and here the wandering Apachès still practise on their prisoners those revolting and indescribable cruelties which make humanity shudder, and which seal their doom of extermination. No less than eighteen summits in the Sierra Blanca have been found to rise

above 14,000 feet. Blanca Peak, in South Colorado, attains 14,464 feet, and is the monarch of mountains, if such there may be, in the great Republic. Lake Tahoe, the largest of western lakes, familiar to readers of the brilliant pages of Miss Bird, was surveyed by Lieutenant Macomb in 1877, and the height of Pyramid Peak ascertained to be 10,003 feet. A town of 20,000 inhabitants (Leadville, Colo.) has sprung into being at an elevation of 11,000 feet, which ranks it among the highest inhabited places on the globe.

Very different in their character are the survey operations of the Canadian Government in the north-west, where the problem presented is to prepare a vast territory, wholly wanting in conspicuous points, for being laid out in townships of uniform area, and farms of uniform acreage. The law requires that the eastern and western boundaries of every township be true astronomical meridians ; and that the sphericity of the earth's figure be duly allowed for, so that the northern boundary must be less in measurement than the southern. All lines are required to be gone over twice with chains of unequal length, and the land surveyors are checked by astronomical determinations. In carrying out this operation, which will be seen to be one of great nicety, five principal meridians have been rigorously determined, and in part traced—the 97th, 102nd, 106th, 110th, and 114th ; and fourteen base-lines, connecting them, have been measured and marked. One of these, on the parallel of $52^{\circ} 10'$, is 183 miles long. Eleven astronomical stations have been fixed since 1876, and from these sixty-six determinate points have been fixed in latitude, forty-five in longitude, often under conditions of no little difficulty from the severity of the climate. The claims of Messrs. Alexander and Lindsay Russell, of Mr. Aldous, and Mr. King, the observers, to rank as scientific travellers, will, I am sure, be warmly recognised by this Section.

The sources of the Frazer river were first reached in February 1875, and found in a semicircular basin, completely closed in by glaciers and high bare peaks, at an elevation of 5300 feet. The hardy discoverer, Mr. E. W. Jarvis, travelled in the course of that exploration 900 miles on snow-shoes, much of it with the thermometer below the temperature of freezing mercury, and lived for the last three days, as he expresses it, 'on the anticipation of a meal at the journey's end.'

We are still imperfectly acquainted with the region north of the parallel of 50° in British Columbia, where the Canadian engineers have long been searching for a practicable railway line from one or other of three known passes of the Rocky Mountains proper, through the tremendous gorges of the Cascade Mountains, to the Pacific. These passes are, the Yellowhead, at an elevation of 3645 feet, the Pine river, at 2800 feet, and the Peace river, said to be only 1650 feet above the sea, all of them comparing very favourably in respect to height with the other transcontinental railways. The Union Pacific Railway, for example, runs, as you will remember, for 1500 miles at elevations of over 4500 feet, and its summit level is 8242 feet. The Dominion Government has recently adopted a line from the Yellowhead Pass to Burrard Inlet, which may be made out in any good map by following the course of the Thompson and Frazer rivers. By this line the Pacific coast will be reached in 1945 miles from Lake Superior, and it is already partly under contract. This is not a place to enter upon engineering details. I will only remark that greater difficulties have seldom been presented to human enterprise than must here be conquered. That peculiar feature in physical geography, the cañon or deep gorge, of which the *Via Mala* is an example familiar to many persons, is presented all over the region upon a scale of grandeur unsurpassed. When not perpendicular cliffs, their sides are in these latitudes seamed by avalanches on the largest scale ; while the mountain torrents which rush down them defy navigation. Mr. Jarvis describes how on one occasion having walked into a hole, concealed by snow, the current caught his snow shoes, turning them upside down, and held him like a vice, so that it required the united efforts of all his party to extricate him.

There is a curious circumstance mentioned in this gentleman's narrative which deserves notice, as an instance of the successful reduction of a native language to writing, free from the difficulties which attend the use of the Roman alphabet. He met with a kind of notice-board or finger-post at the dividing of two tracks on the

prairie, having upon it characters, which were entirely unknown to himself and his companions, and apparently to the Railway Department—

TL-WBQ² V" DQD² DDC² L² →

They are, in fact, characters of a phonetic alphabet, invented forty years ago by a Mr. Evans, a Wesleyan missionary among the Cree Indians, and are extremely well adapted for expressing their liquid polysyllabic language. That they should have survived the generation to which they were first taught, and be still used for communication on the plains, is a fact which would have given great gratification to their excellent author.¹

The final decision of the Canadian Government to adopt Burrard's Inlet for the Pacific terminus of their railway, relegates to the domain of pure geography a great deal of knowledge acquired in exploring other lines: explorations in which Messrs. Jarvis, Horetsky, Keefer, and others, have displayed remarkable daring and endurance. They have forced their way from the interior to the sea-coast or from the coast to the Peace River, Pine or Yellowhead Passes, through country previously unknown, to Port Simpson, to Burke Channel, to the mouth of the Skeena, and to Bute Inlet, so that a region but recently almost a blank on our maps, which John Arrowsmith, our last great authority, left very imperfectly sketched, is now known in great detail, and I regret to add, the better known, the less admired. The botany has been reported on by Mr. Macoun, and the geology by Dr. Dawson, *pari passu* with its topography. I have great hope that the Section will receive from the last-named traveller in person some account of his many arduous journeys in the prosecution of geological research. Of these, the latest is the exploration of Queen Charlotte Islands, a part of the British possessions, very little known to most of us, although we had a communication on the subject in 1868. He regards them as a partly submerged mountain chain, a continuation north-westward of that of Vancouver's Island and of the Olympian Mountains in Washington Territory. An island, 156 miles long and 56 wide, enjoying a temperate climate, and covered with forests of timber of some value (chiefly *Abies Menziesii*), is not likely to be left to nature much longer. But the customs of the natives in regard to the inheritance and transfer of land are unfavourable to settlement, and will demand just and wise consideration when the hour comes. It is as much private property as any estate in Wales.

Mr. Dawson's report contains a vocabulary of the language, which presents this peculiarity, that the words expressing family relationship vary with the speaker. Thus 'father' said by a son is *Haung*; said by a daughter, is *Hah-ta*. 'Son,' said by a father, is *keet*; said by a mother, is *kin*. Evidently at some period the mothers were captives of a different tribe. It would be difficult to produce on the globe a more conspicuous example of the beneficent effect of missionary influence, combining industrial with religious instruction, than has been presented by the Tsimpseean Indians at Metla Katla, under Mr. Duncan, a layman commissioned by the Church Missionary Society.

I must now call your attention to the remarkable explorations, little known in this country, of l'Abbé Petitot, also a lay missionary (Frère Oblat) of the Roman Catholic Church, in the Mackenzie River district, between Great Slave Lake and the Arctic Sea, a region which that Church has almost made its own. Starting sometimes from St. Joseph's mission station, near Fort Resolution, on Great Slave Lake, sometimes from S. Theresa, on Great Bear Lake, sometimes from Notre Dame de Bonne Espérance on the Mackenzie, points many hundreds of miles asunder, he has on foot or in canoe, often accompanied only by Indians or Esquimaux, again and again traversed that desolate country in every direction. He has passed four winters and a summer on Great Bear Lake, and explored every part of it. He has navigated the Mackenzie ten times between Great Slave

¹ The words, read by Archdeacon Hunter, are 'oomah maskemow pache oonahne aetabmoo,' and their purport is a direction. 'This road, come, oonahne flee thou.' He cannot make out *oonahne*.

Lake and Fort Good Hope, and eight times between the latter post and its mouth. We owe to his visits in 1870 the disentanglement of a confusion which existed between the mouth of the Peel River (R. Plumée) and those of the Mackenzie, owing to their uniting in one delta, the explanation of the so-called Esquimaux Lake, which, as Richardson conjectured, has no existence, and the delineation of the course of three large rivers which fall into the Polar Sea in that neighbourhood, the 'Anderson,' discovered by Mr. MacFarlane, in 1859, a river named by himself the Macfarlane, and another he has called the Roncière. Sir John Richardson was aware of the existence of the second of these, and erroneously supposed it to be the 'Toothless Fish' River of the Hare Indians (Beg-hui-la on his map.) M. Petitot has also traced and sketched in several lakes and chains of lakes, which support his opinion that this region is partaking of that operation of elevation which extends to Hudson's Bay. He found the wild granite basin of one of these dried up, and discovered in it, yawning and terrible, the huge funnelled opening by which the waters had been drawn into one of the many subterranean channels which the Indians believe to exist here.

These geographical discoveries are but a small part of l'Abbé Petitot's services. His intimate knowledge of the languages of the Northern Indians has enabled him to rectify the names given by previous travellers, and to interpret those descriptive appellations of the natives, which are often so full of significance. He has profoundly studied their ethnology and tribal relations, and he has added greatly to our knowledge of the geology of this region.

It is, however, much to be regretted that this excellent traveller was provided with no instruments except a pocket watch and a compass, which latter is a somewhat fallacious guide in a region where the declination varies between 35° and 58° . His method has been to work in the details brought within his personal knowledge, or well attested by native information, on the basis of Franklin's charts.

M. Petitot expresses his persuasion that the district of Mackenzie river can never be colonized—a conclusion no one, who has visited it, will be disposed to dispute; but he omits to point out that the mouth of that river is about 700 miles nearer the port of Victoria, in British Columbia, than the mouth of the Lena is to Yokohama, and far more accessible. It needs no Norden skield to show the way. Its upper waters, the Liard, Peace, Elk, and Athabasca rivers, drain an enormous extent of fertile country, not without coal or lignite, and with petroleum in abundance. As the geological survey has not yet been extended so far, we are not fully acquainted with its mineral resources; but I can add my testimony to that of more recent travellers, as to the remarkable apparent fertility, and the exceptional climate of the Peace River valley. It is no extravagant dream that sees in a distant future the beneficent influence of commerce, reaching by this great natural channel, races of mankind, in a high degree susceptible to them; and alleviating what appears to us to be the misery of their lot.

There are few subjects of greater physical interest, or which have received less investigation, than the extent to which the soil of our planet is now permanently frozen round the North Pole. Erman, on theoretical grounds, affirms that the ground at Yakutsk is frozen to a depth of 630 feet. At 50 feet below the surface it had a temperature of $28^{\circ}5$ F. (-6° R.), and was barely up to the freezing point at 382 feet. It is very different on the American continent. The rare opportunity was afforded me by a landslip on a large scale, in May 1844, of observing its entire thickness, near Fort Norman, on Mackenzie river, about 200 miles further north than Yakutsk, and it was only 45 feet. At York Factory and Hudson's Bay it is said to be about 23 feet. The recent extension of settlement in Manitoba has led to wells being sunk in many directions, establishing the fact that the permanently frozen stratum does not extend so far as that region, notwithstanding an opinion to the contrary of the late Sir George Simpson. Probably it does not cross Churchill river, for I was assured that there is none at Lake à la Crosse. It depends, in some measure, on exposure. In the neighbourhood of high river banks, radiating their heat in two directions, and in situations not reached by the sun, the frost runs much deeper than in the open. The question, however, to which Sir John Richardson called attention so

long ago as 1839, is well deserving of systematic enquiry, and may even throw some light on the profoundly interesting subject of a geographical change in the position of the earth's axis of rotation. Indeed, Dr. Haughton has actually, on other grounds, assigned a position in the neighbourhood of Yakutsk to the pole of the earth in Miocene times.

The Saskatchewan was first navigated by steam in 1875, when a vessel of about 200 tons ascended from the Grand Rapid to Edmonton, 700 miles. There is, however, an obstacle at Cole's Falls, below Carlton House, which has led to a break of navigation, and a small steel steamer, originally intended for the Upper Athabasca, has recently been transferred to the Upper Saskatchewan; between the two, it is now navigated from the Grand Rapids, near Lake Winnipeg, to the base of the Rocky Mountains. A steamer also plies regularly on Lake Winnipeg, and has ascertained many interesting particulars, of which we have hitherto been ignorant. Its greatest depth does apparently not exceed 100 feet. Its discharge has at last been followed by Dr. Robert Bell, down the Nelson river, to the sea. That gentleman reports the impediments to navigation to be insuperable, and a company has been very recently formed to make a railway from the lowest navigable point to the mouth of the Churchill river.

Our hopes of further light upon the history of the ill-fated Franklin expedition, based on information given by a Netchelli Esquimaux, to the American Captain Potter in 1872, have been again disappointed. An American search expedition landed at Dépôt Island, (lat. 64°), in the neighbourhood of which traces were reported, in August 1878, wintered there, and examined the country, as yet with no result, except a correction of the charts.

Hudson's Bay itself cannot fail at no distant day to challenge more attention. Dr. Bell reports that the land is rising at the rate of 5 to 10 feet in a century, that is, possibly, an inch a year. Not however, on this account will the hydrographer notice it; but because the natural seaports of that vast interior now thrown open to settlement, Keewatin, Manitoba, and other provinces unborn, must be sought there. York Factory, which is nearer Liverpool than New York, has been happily called by Prof. H. Y. Hind, the Archangel of the West. The mouth of the Churchill, however, although somewhat further north, offers far superior natural advantages, and may more fitly challenge the title. It will undoubtedly be the future shipping port for the agricultural products of the vast north-west territory, and the route by which emigrants will enter the country.

Before leaving this quarter I must allude to the praiseworthy efforts of some of the Western States, especially Nebraska and Minnesota, to encourage the planting on the great plains by premiums, in which they have been followed by our own Province of Manitoba. Many years must elapse before the full climatic effects can be realized, but in time they cannot be doubtful, and with the impending disappearance of the buffalo, will disappear much of that arid treeless region, embracing nearly 600,000 square miles, which he now wanders over, and assists to keep bare by so doing. On the other hand, the short-sighted and destructive habit of burning off the prairie grasses to promote a young growth, increases with settlement, and is chargeable with incredible mischief. These fires have the curious effect, when they extend into wooded regions, of helping to exterminate the more slow-growing and valuable descriptions of timber, and favouring the prevalence of the more worthless quick-growing kinds. But the Indians are even more chargeable with them than the whites, and the traveller encounters few more melancholy sights than a forest of charred and lifeless trunks extending over an area as large as a county, the fruit perhaps of a signal from one band to another.

A discourse on American geography would be incomplete without reference to that great design of piercing the Isthmus of Panama, with which Count Ferdinand de Lesseps has connected his name. Out of the conflict of about ten competing lines, the oldest and the youngest alone survive. The route by Lake Nicaragua appeared possible even to Cortez. It was accurately surveyed nearly seventy years ago, and the estimates, although they have grown alarmingly, are still within practicable limits. It has the preference of the highest authorities in the United

States. Its total length would be 180 miles, including fifty-six miles of lake navigation, with a summit level, to be attained by lockage, of 107·6 feet.

The Panama route would shorten the canal to one-fourth of this length, and it is a cardinal point with its author to dispense altogether with locks. As we are favoured by the presence of Lieut. Bonaparte Wyse—M. de Lesseps' coadjutor—I need say no more, except that the enthusiastic reception given to M. de Lesseps here in Swansea, not many weeks ago, is sure evidence that this great industrial centre takes a keen interest in his project from a commercial point of view; and we may safely leave capitalists, engineers, and diplomatists to fight out their battle, only concerned that by one route, if not by both, the world may reap in our day the vast benefit it already owes, in another quarter, to his genius and indomitable perseverance.

One of the most interesting questions in the whole range of geography still awaits positive proof or disproof in this region. I refer to the often asserted existence of a native race in Central America which holds no communication with Europeans, and preserves its ancient language, religion, and civilisation unchanged from the time of the Spanish Conquest. Antecedently so improbable as to be well-nigh incredible, it found credit with Mr. Stephens and Mr. Catherwood and Mr. Norman. A later traveller, Captain Carmichael, expressed, at this Association in 1870, his firm belief in it; and I will, with your permission, read an extract from a letter dated January last, which I received from that enthusiastic explorer, Dr. Le Plongeon, who has been for several years engaged in investigating the ruins of Central America.

'I have been told that there are many tribes in the interior of the country that have had but little contact with the Spaniards, and therefore have retained the purity of their language. This causes me to tell you here that the report—which many think hypothetical, of a vast extent of country, some assert 500 miles, comprised between Tabasco, Guatimala, Peten, and Yucatan, very mountainous, well-nigh inaccessible, that is inhabited by the remnants of various warlike tribes, the Chinamaces, the Laucaerones, the Itzaks, and others, who flying before the Spaniards, have fortified themselves in very rich valleys, where they live to the present day as their fathers, at the time of the arrival of the Spaniards, and speak the pure unadulterated Maya—is not far from being true. I have enquired from parties who have lived in the neighbourhood of the Tierra de la Guerra, as they call it, and learn that people coming from the unknown regions are sometimes seen in the villages of the neighbourhood, where they barter tobacco, cocoa, and other products of their industry, for whatever they want; that of late some came to hire on the farm as labourers, but will not allow any white to penetrate their stronghold.'

Tierra de la Guerra is an old designation for the region in which the boundaries of Honduras, Yucatan, and Guatimala meet, and which contains some twenty-five or thirty thousand square miles, an area quite extensive enough for small aboriginal communities to be hidden away in it; and, if as Dr. Le Plongeon thinks, the long-sought key to the Mexican hieroglyphics should be preserved among them, there is a brilliant reward for the first scientific traveller who, without shedding blood, can penetrate into their fastnesses. We shall, I trust, hear more of this region from a gallant and enterprising traveller, the Colonial Secretary of British Honduras, who has already penetrated its outskirts, and wants nothing more than a little aid and encouragement to advance beyond them. In a recent letter to me, Mr. Fowler says:—

'On the east coast of Yucatan, not far from the sea-coast, are the ruins of three cities, and close to our own frontier is a ruin which, the Indians tell me, contains plenty of mural paintings on the inside walls of the chambers. All these ruins are under the control of the Santa Cruz Indians. The chiefs of these Indians lately visited Belize and were shown much attention. I had them particularly in my charge. They received a Martini-Henry rifle each and we swore mutual confidence in each other. They invited me to their country, promising me a safe conduct, and gave me leave to visit any ruin and take away what I liked.'

That such an opportunity should be lost for want of a very moderate sum to

defray the expenses of an expedition would be a matter of regret, which all present will share, and I am not without hopes that ways and means may be raised, through the co-operation of those who are interested in the subject from an historical, as well as a geographical point of view, to enable Mr. Fowler to carry out his project.

The Section will assuredly hear with pleasure that Mr. Edward Whymper, whose recent mountain-ascents in Ecuador have roused the interest of geographers and Alpine climbers in so high a degree, will probably favour us with some account of them.

It appears probable that we shall owe to America the solution of a question which, even within the limited area of these islands, often occupies our Courts of Law, and troubles us in daily life. I mean a definition of civil time. We have an extreme difference of time between Yarmouth and Valentia of about $48\frac{1}{2}$ minutes; but the merchant at San Francisco finds himself $3\frac{1}{4}$ hours behind his correspondent in New York, and the consequence has been an irregular acknowledgment of no less than seventy-five local standards of time on different railways in the United States. These it is now proposed to reduce to five, of exactly one hour interval, which would equally suit the Dominion of Canada. Mr. Sanford Fleming, late Engineer-in-Chief of the Canada Pacific Railroad, advocates the still bolder measure of adopting the meridian of 180° , as a meridian for railway and telegraph time all over the world. It is not unworthy of this Section to aid in the preparation of the public mind for the legal adoption of prime meridians in this country at about ten-minute intervals. Thus Greenwich time might rule from Yarmouth to Winchester; Bath time from Winchester to Exeter, and so on; the first step towards which will be substituting meridians at $1\frac{1}{4}^{\circ}$ interval, corresponding to five minutes of time, for the unmeaning lines at 1° or 5° of angle, which are drawn on school maps at present.

I shall, perhaps, be accused of poaching on the manor of a brother President, if I venture to allude to another subject which belongs rather to the Geological Section. But a railway guide is surely a geographical manual, and in the American Geological Railway Guide of Mr. Macfarlane, we have a model and example of what may be done to disseminate knowledge, which I think worthy of passing notice. This work tells the traveller, and the resident no less, the chief geological characteristics of the neighbourhood of every railway station in the United States. Is it extravagant to suppose that the same information, with the addition of the name of the county, the height above the sea, the prevailing industry, the population, the rainfall, the climate, and other constants, may be some day furnished by our great companies to the intelligent strangers who spend so many weary minutes in waiting at every station?

Turning now from a quarter on which I fear I have nearly exhausted your patience—from the West to the East. It is now nearly forty years since the corps of Royal Engineers was first associated in the exploration of Palestine by the employment of Captain Symonds, R.E., to determine the depression of the Dead Sea. The recent completion of the great map of that country is a performance whose unrivalled Biblical and topographical importance should not blind us to its geographical interest. The first surveyed of all known lands, it is also the last.

Siloa's brook that flowed
Fast by the oracles of God

is traced again, and the surprising local accuracy of the sacred writers established upon testimony beyond dispute.

The British survey, as you are aware, has been limited to the country west of the Jordan, an American Association having charged itself with the survey east of that stream. This is not yet published; but I trust that we shall have from Mr. Lawrence Oliphant an account of a part of that little known region, from which he has lately returned.

Operations of war have been in all ages fruitful of geographical knowledge;

many an old soldier of Alexander, we may be sure, was cross-examined by Eratosthenes; many a centurion of Hadrian related his weary marches in Gaul or Britain to Ptolemy, before those ancient geographers acquired the imperfect knowledge which served the world for so many centuries. The first legion that crossed the Alps accomplished a feat as arduous as the passage of Shutargardan or the Balkans, but it left us no record. To our own and the Russian Topographical Staff in Central Asia we owe, on the contrary, a series of explorations conducted under every difficulty, which must vastly facilitate the access of commerce to those distracted regions. Referring here to the former alone, they may be divided into three groups:—

1. Southern Afghanistan, embracing Quetta and Kandahar.
2. The Kuram valley and generally the south of the Safed Koh range.
3. The north of the Safed Koh range, including the valley of the Kabul river and that city itself.

In the first of these an entirely new route through the villages of Tal and Chotiali, crossing several mountain passes, was followed by Major-General Sir M. Biddulph's column, and surveyed by Captain T. H. Holdich. Much new country was also surveyed by Lieutenant-Colonel W. M. Campbell between Pishin and the Afghan desert. This officer thrice crossed the table-land of Toba, and by means of the field electric telegraph, has determined the difference of longitude between Quetta and Kandahar.

On the south of the Safed Koh range we have at least 3000 square miles surveyed by Major R. G. Woodthorpe, embracing the Shutargardan pass and the range which divides the Kuram from the Khost valley. This officer, accompanied by Captain Martin, ascended in 1878 the highest peak on the Safed Koh range (Sikaram, 15,622 feet), but unfortunately was disappointed of observations, by the hot-weather haze, which enveloped the peaks of the Hindu-kush. Mr. G. B. Scott, a civilian surveyor, was more successful, and obtained observations to all of them.

On the north of the Safed Koh range over 2200 square miles of new country were surveyed in 1878-9. The Shinwaries and Khagianis have, however, an insuperable aversion to plane tables and theodolites, and it was in no spirit of kindness that they gained for the gallant Captain E. P. Leach, R.F., his Victoria Cross. Less has been learnt about their country than could be wished. I am not over-stating the services of our Topographical Staff in Afghanistan in estimating the aggregate of ground covered by their surveys or sketches at 140,000 square miles, and we have, through Major Tanner, got a little information respecting the almost unknown land of Kafiristan, lying to the north of Jellalabad. Disguised as a Kabuli, this gallant officer entrusted himself to a friendly Chagani chief, and penetrated some distance into that rugged country. He says of the principal village that the houses are piled one above another, and every beam, doorway, and shutter carved in a most elaborate manner. The designs, he adds, are crude, but such a mass of carving he had never seen before. The taste reminds us curiously of that of the mountaineers of Switzerland and the Tyrol. I regret that the limits of an address do not permit justice to be done to the services of these gallant officers.

In Zululand about 9000 square miles of country have been triangulated, and the details filled in, to some extent, at our Intelligence Department, from the numerous sketches of the staff; no such systematic survey was, however, attempted in this quarter as in Asia—a fact to be regretted, when we remember the excellent opportunity which the military occupation of a country affords for combined explorations.

In Central Africa we have the information given to Commander Cameron by his native guides, in 1874, that a river they called the Lukuga, which he descended four or five miles, is the outlet of Lake Tanganyika, confirmed and placed beyond dispute by the Rev. E. C. Hore, of the London Missionary Society, who entered it in April, 1879, found it free from the obstructions which arrested Cameron, and was

able to go further down. Since which time, and quite recently, its course has been followed by Mr. Joseph Thomson, almost to its junction with the Lualaba. The discovery is of extreme interest from every point of view, especially as pointing to the probable line of future communication of the regions bordering that great inland sea, with the Atlantic, although the river itself, at least after the rainy season, is reported to be utterly impassable for canoe or boat of any description. I trust we may have some preliminary account of it from the traveller himself. As you are aware he embarked for England on July 16, and doubtless will, if he shall arrive in time, afford us an opportunity of congratulating him on the safe accomplishment of one of the most brilliant and successful tropical expeditions on record. The most youthful of African travellers, for he is only 22 or 23 years of age, Mr. Thomson has carried out every point in the programme laid down for his late lamented Chief, Mr. Keith Johnstone, has done it admirably, and done it at a very moderate cost.

Time does not permit me to follow all the phases of that new-born activity which is establishing centres of exploration and of civilisation at every great lake in Africa. The Belgian Expedition, conducted by Mr. Stanley, and the Baptist Missionary Expedition from San Salvador or Congo, are still aiming at the same point, viz., to reach Stanley Pool, above the falls, on the river Congo, the first by ascending the river, the latter by overland route, by way of Makuta or Zombo. The latter have met with great opposition at Makuta, and by the last account had not got within 100 miles of the Pool. That munificent benefactor of African missions, Mr. Robert Arthington, of Leeds, has paid a sum of 4000*l.* to the Baptist Society with a view to placing a small steamer on the river as soon as practicable, of establishing stations on the Ikelamba and M'bura rivers, and of opening communication by the latter with Lake Albert Nyanza. Much of this country is entirely unexplored.

The road from Dar-es-Salaam on the east to Lake Nyassa, about 350 miles, has been carried through the coast jungle. Mr. Beardall, the chief engineer, has located the first section of about 100 miles to the valley of the Rufiji, and proposes to make use of the tributary river Uranga as far as navigable, up stream, towards the mountains which border the lake, before resuming his road-making. The highways of Central Africa, whether by land or water, exist as yet only in the hopes of philanthropists and the dreams of commerce, and I fear we must include among the visions, that artificial sea which some geographers have proposed to make by conducting the waters of the Atlantic or the Mediterranean into depressions known to exist in the great Sahara. The subject has been examined by Herr v. Wurtegg, a German traveller, who will, I have reason to hope, favour us with a communication on the subject. Meanwhile, it appears to be tolerably well established that wells can be sunk almost anywhere, each becoming a centre of vegetation and productiveness.

I feel, ladies and gentlemen, that I have detained you from the business of the Section an inordinate time. But then I may remind you that when the British Association last met at Swansea this Section (which was then combined with that of Geology), escaped an address altogether. A generation has passed away since; of the eminent men then present in office some half-dozen alone remain, and in the retrospect it is so natural to take, the growth of geographical information stands out in remarkable prominence. Still—

The cosmographer doth the world survey,

and finds an illimitable field for the improvement of old, or the acquirement of new knowledge. Better methods of instruction, better books, and, above all, better maps, are changing the aspect of the study to the young, every traveller who settles one question raises others for his successors, so that 'no man can find out the work that God maketh from the beginning to the end.' Its perpetual youth is the charm of our science; may it also be my excuse.

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